

# PREMIXED COMBUSTION GAS BURNER HAVING SEPARATED FIRE HOLE UNITS

## BACKGROUND OF THE INVENTION

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### 1. Field of the Invention

The present invention relates to a premixed combustion gas burner having separated fire hole units, and more particularly, to a premixed combustion gas burner having separated fire hole units in which a total number of fire hole units formed on the surface of the burner are separated into several pieces in the premixed combustion gas burner having a tube-shaped burner and a plate-shaped burner which are separated from each other, and a cooling water tube penetrates a pin structure formed on the lower end of the plate-shaped burner, to thereby easily change the size and number of the fire hole units to easily change a total capacity of the burner, prevent deformation of the burner such as buckling due to thermal tension existing in the burner which may be caused by an excessive running of the burner and thermal expansion deformation, and play a role of making the water tube fixing the tube-shaped burner and the plate-shaped burner.

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### 2. Description of the Related Art

As is well-known, a boiler for heating and supplying hot water for use in a general home, is divided into an oil boiler and a gas boiler, according to a fuel used. The oil boiler or the gas boiler uses a burner for burning oil or gas which is used in the boiler.

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That is, a general burner is equipment which obtains heat by burning fuel in safety and with good efficiency. According to a kind of fuel used, the burner is classified into a gas burner for combustion of gas, an oil burner for combustion of liquid fuel such as kerosene or diesel oil, and a powdered coal burner for combustion of coal.

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Also, the burner is divided into a premixed combustion burner and a diffusion

combustion burner according to a method for mixing fuel and air.

The premixed combustion burner burns fuel and air which have been mixed in advance and the diffusion combustion burner burns mixed fuel and air in which fuel and air are separately supplied to a burner and mixed therein.

5 That is, most of gas burners which are widely used in a gas burner such as a home gas boiler chiefly adopts a Bunsen gas burner having advantages of a stability of flames of the burner and running few risk of causing a backfire. However, the Bunsen gas burner has long flame and high flame temperature and needs a much more amount of air than a theoretical amount of air. Accordingly, a loss of heat increases due to high-temperature exhaust gas and  
10 an amount of polluted materials such as  $\text{NO}_x$  and CO increases. As a result, the Bunsen gas burner is limited to a degree to accomplish maximization of an efficiency and reducing of polluted materials.

Also, a premixed combustion gas burner using knitted metal fiber mat of porous metal fiber weaving tissue which is used as a surface material of a combustion gas burner is  
15 used to reduce polluted materials such as  $\text{NO}_x$  and CO and flame temperature. The knitted metal fiber mat of porous metal fiber weaving tissue which is used as a surface material of a combustion gas burner is woven like a fiber tissue with a metallic material of  $50\mu\text{m}$  or less in diameter, which is used as the surface material of the combustion gas burner to perform perfect combustion of inflammable premixed gas on the combustion surface, and then heat the  
20 combustion surface of the gas burner formed of the knitted metal fiber mat of metal fiber weaving tissue with the combustion heat to thereby obtain strong and uniform solid-state radiation energy from the combustion surface of the gas burner.

Also, a loss of heat due to exhaust gas is reduced by reducing an amount of excessive air for combustion and lowering the temperature of combustion exhaust gas, to  
25 thereby provide an effect of increasing a thermal efficiency and suppressing polluted materials such as  $\text{NO}_x$  and CO to be discharged. Also, a range of a combustion load (a turndown ratio: TDR) is considerably wider than that of the general gas burners whose TDR is 5 to 1. Also, the stability of flame is remarkably superior to the that of the general gas burner and employs a simple structure. As described above, the knitted metal fiber mat of

porous metal fiber weaving tissue is widely used as a combustion surface material for a gas burner for a home use, commercial use and industrial use in order to enhance a thermal efficiency and lower polluted materials in gas combustion equipment, together with ceramic and stainless steel.

5           In particular, materials such as ceramic or stainless steel, and knitted metal fiber mat of porous metal fiber weaving tissue are used as a combustion surface material for a gas burner. Since the knitted metal fiber mat of porous metal fiber weaving tissue has a thermal treatment effect which lowers the temperature of the rear surface of the burner into an ignition temperature or less, it is known as a safe material having burner flames running few risk of  
10 backfiring through small holes on the knitted metal fiber mat of porous metal fiber weaving tissue, when the knitted metal fiber mat is used as the combustion surface material of the gas burner in order to perform combustion of the premixed gas. Thus, the gas burner using knitted metal fiber mat of porous metal fiber weaving tissue has an advantage of having no need to specially countermeasure a backfire phenomenon, which is used to reduce polluted  
15 materials such as NO<sub>x</sub> and CO and lower the temperature of flames.

          However, in the case of the temperature of flames is low in the conventional premixed combustion gas burner, the burner flames may be unstable, much production cost may be incurred, and it may be difficult to fabricate it. Also, it may happen that it is somewhat difficult to stably control combustion of the premixed gas in home gas burner  
20 equipment which is designed in simple structure.

          Also, in the case that ceramic, stainless steel, or knitted metal fiber mat of porous metal fiber weaving tissue is used as a combustion surface material of the premixed combustion gas slits, a premixer for premixing fuel gas and air may become large and somewhat complicated. As a result, an air blowing resistance increases due to a loss of  
25 pressure in the premixer and thus abnormal noise may occur at part of a high-load region during combustion or main flames of the gas burner may be unstable.

          As described above, in the case of the conventional premixed combustion gas burner, fire hole units forming a burner are formed on a single plate-shaped material or

cylindrical vessel, or knitted as metal fiber. When fire hole units are formed on a single plate-shaped material or cylindrical vessel, the burner surface may be twisted due to thermal expansion. When metal fiber is used in a gas burner, the metal fiber is pulled and then assembled during assembling, to thereby cause fire hole units to be formed largely locally or  
5 in whole on the metal fiber, and thus cause scattering of the flames, which may cause flames to be ununiform and a backfire to occur.

Also, the conventional premixed combustion gas burner has various problems that it is expensive and difficult to fabricate it.

In particular, the conventional premixed combustion gas burner taking a tubular  
10 shape has demerits that it is difficult to prevent deformation such as buckling due to a thermal tension at the time of an excessive running of the burner, damage by a fire of the burner surface due to overheat, and excessive production of nitrogen oxide due to heat.

Also, the conventional premixed combustion gas burner has a problem that it is difficult to mount a separate device such as a cooling water tube for cooling overheat of the  
15 burner.

## SUMMARY OF THE INVENTION

To solve the above problems, it is an object of the present invention to provide a premixed combustion gas burner having separated fire hole units, in which a total number of  
20 fire hole units formed on the surface of the burner are separated into several pieces, to thereby prevent deformation due to thermal expansion, and easily change the size and number of the fire hole units to easily change a total capacity of the burner.

It is another object of the present invention to provide a premixed combustion gas burner having a tube-shaped burner and a plate-shaped burner which are separated from each  
25 other, in which a cooling water tube penetrates a pin structure formed on the lower end of the plate-shaped burner, to thereby prevent deformation of the burner such as buckling due to thermal tension existing in the burner which may be caused by an excessive running of the burner, lowering the temperature of flames to reduce an amount of nitrogen oxide to be

produced, preventing damage by a fire due to cumulative heat on the burner surface, and playing a role of making the water tube fixing the tube-shaped burner and the plate-shaped burner.

To accomplish the above object of the present invention, there is provided a premixed  
5 combustion gas burner having separated fire hole units comprising: a tube-shaped burner whose front face is opened and inner portion is of a hollow tubular shape so that the whole fire hole units of the burner can be separated to thus prevent deformation due to thermal expansion, in which fire hole units each having a number of fire holes formed at a  
10 predetermined distance from one another are disposed in both edge lines and the inner portion on the upper end face, and loaders each having a predetermined space are formed between the fire hole units; and a plate-shaped burner which is made of a plate-shaped material having a pin structure formed on the bottom thereof so as to be mounted on the loaders formed in the  
15 tube-shaped burner, in which fire hole units having a number of fire holes formed at a predetermined distance are disposed in the form of a slit along both the edge lines of the upper end face.

Here, the number of fire holes forming the fire hole units of the tube-shaped burner and the plate-shaped burner are formed with a uniform size by a press.

Preferably, a cooling water tube is disposed to penetrate the fire holes through fitting  
20 holes formed on the lateral surface of the tube-shaped burner and fitting holes formed on the pin-structure formed on the bottom of the plate-shaped burner, in correspondence to the fitting holes of the tube-shaped burner.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The above and other object and advantages of the present invention will become  
25 more apparent by describing the preferred embodiment thereof in detail with reference to the accompanying drawings in which:

FIG. 1 is a perspective view showing a tube-shaped burner forming a premixed combustion gas burner according to the present invention;

FIG. 2 is a perspective view showing a plate-shaped burner forming a premixed combustion gas burner according to the present invention;

FIG. 3 is a perspective view showing an assembly state of the premixed combustion gas burner according to the present invention;

5 FIG. 4 is a perspective view showing an assembly state where a cooling water tube is assembled with the premixed combustion gas burner according to the present invention;

FIG. 5 is an exploded perspective view showing the whole configuration of a combustion gas burner in which the premixed combustion gas burner according to the present invention is applied; and

10 FIG. 6 is a cross-sectional view showing an assembly state of the combustion gas burner of FIG. 5 according to the present invention.

#### DETAILED DESCRIPTION OF THE INVENTION

15 A premixed combustion gas burner having separated fire hole units according to a preferred embodiment of the present invention will be described below with reference to the accompanying drawings.

Referring to FIGS. 1 through 3, a premixed combustion gas burner having separated fire hole units includes a tube-shaped burner 20 in which fire hole units 21 each having a number of fire holes formed at a predetermined distance from one another are disposed on the upper end face, for burning gas and air which are supplied in a mixed state, and a plate-shaped burner 30 which is detachably disposed in loaders 22 formed between the fire hole units 21 formed on the upper end of the tube-shaped burner 20, in which fire hole units 31 having a number of fire holes are disposed.

25 Here, as shown in FIG. 1, in the tube-shaped burner 20 according to the present invention whose front face is opened and inner portion is of a hollow tubular shape, fire hole units 21 each having a number of fire holes formed with a uniform size at a predetermined distance from one another are disposed in both edge lines and the inner portion on the upper end face. Loaders 22 are formed between the fire hole units 21 which mount the

plate-shaped burner 30 between the fire hole units 21 in turn.

Here, it is preferable that the fire holes constituting the fire hole units 21 are formed of a circular shape or tubular shape, respectively.

Also, the tube-shaped burner 20 is formed of a number of tubular burners connected  
5 in parallel with one another, in units of a single tubular shape.

Here, a plurality of fitting holes 23 through which a cooling water tube 70 of FIGs. 4 and 5 is fitted and which is fixedly connected with the plate-shaped burner 30 which will be described later, are formed at a predetermined distance on the lateral surface of the tube-shaped burner 20.

10 Also, as shown in FIG. 2, the plate-shaped burner 30 mounted on loaders 22 formed in the tube-shaped burner 20 is a burner made of a plate-shaped material on which a protruding pin structure 32 is formed with a predetermined curvature.

That is, the plate-shaped burner 30 has a structure that fire hole units 31 are disposed along both edge lines on the upper surface of the plate-shaped material, in which each fire  
15 hole unit has a number of fire holes at a predetermined distance in the form of a slit of a uniform size, like the tube-shaped burner 20.

Also, fitting holes 33 formed on the pin-structure 32 formed on the bottom of the plate-shaped burner 30, through which a cooling water tube 70 of FIG. 4 can penetrate are formed in correspondence to the fitting holes 23 of the tube-shaped burner 20.

20 In particular, fire hole units 21 and 31 each having a number of fire holes formed in the tube-shaped burner 20 and the plate-shaped burner 30 has a uniform performance in a single burner because each fire hole is uniformly formed by a press.

The tube-shaped burner 20 and the plate-shaped burner 30 having the above-described structures constitute a single premixed combustion gas burner in which the  
25 plate-shaped burner 30 is mounted on the loaders 22 of the tube-shaped burner 20.

Here, the fire hole unit 21 of the tube-shaped burner 20 is located in the middle of the plate-shaped burners 30, and the fire hole unit 21 of the tube-shaped burner 20 makes flames easily transmitted between the plate-shaped burners 30. When the tube-shaped burners 20

are connected in parallel with one another, the leftmost and rightmost fire hole units 21 play a role of easily transmitting flames between the tube-shaped burners 20.

As shown in FIGs. 5 and 6, the premixed combustion gas burner according to the present invention having the above-described structure employs a structure of performing a multi-stage control of a burner in which premixed combustion gas burners each which includes several tube-shaped burners 20 and several plate-shaped burners 30 whose output capacity is identical are disposed in parallel with one another to thereby perform a combustion operation by varying the number of burners according to a desired heat capacity.

That is, the premixed combustion gas burner has a main casing 10 on the bottom surface of which an air blower 50 is mounted so that air can be supplied from the air blower 50 through an air inlet 11 formed on the lower portion of the premixed combustion gas burner.

Here, a partition 13 partitioning between the air blower 50 mounted on the bottom of the main casing 10 and the tube-shaped burner 20 is formed at a distance from the bottom surface of the main casing 10. Also, the tube-shaped burner 20 is loaded over the partition 13.

As described above, the premixed combustion gas burner formed of the tube-shaped burner 20 and the plate-shaped burner 30 is disposed in parallel on the partition 13 provided in the main casing 10.

Also, a number of mixture supply tubes 40 which are inserted into the tube-shaped burner 20 and disposed at a distance from each other are provided in the front surface of the main casing 10 so that gas and air can be mixed and supplied to the tube-shaped burner 20 and the plate-shaped burner 30 according to the present invention. Also, Venturi tubes 60 playing a role of mixing gas and air and distributing the mixed flow amount which are needed for combustion of the burner and independently supplied to each burner are installed on the front surface of the mixture supply tubes 40.

As described above, the mixture supply tubes 40 inserted and mounted into the tube-shaped burner 20 are provided in the front surface of the tube-shaped burner 20. The

mixture supply tubes 40 play a role of mixing gas and air and supplying the mixture to the burner as described above, and supplements a demerit that the conventional premixed combustion gas burner should include a separate mixing chamber. In the mixture supply tubes 40, gas and air are supplied through separate paths simultaneously and then mixedly  
5 supplied to the burner at the state where gas and air are mixed while passing through the mixture supply tubes 40.

As described above, the Venturi tubes 60 playing a role of mixing gas and air and distributing the mixed flow amount which are needed for combustion of the burner and independently supplied to each burner are installed on the front surface of the mixture  
10 supply tubes 40.

That is, since gas and air are mixed through the mixture supply tubes 40 and the Venturi tubes 60 during inflow of gas and air and the mixture is supplied to the burner in the present invention, a separate mixing chamber which is required in the conventional premixed combustion gas burner is not needed. Thus, secondary air need not be supplied to  
15 the burner in the present invention, which is a typical premixed combustion gas burner.

Also, an inlet hole 90 called manifolders through which air and gas can be supplied is provided in front of each of the Venturi tubes 60. Accordingly a separate unit for mixing air and gas is not needed. Gas is supplied from nozzles closely installed in front of the Venturi tubes 60.

20 That is, the Venturi tubes 60 and the mixture supply tubes 40 are installed in the inlet holes 90 in which gas sprayed and supplied from the nozzles and air supplied from the air blower 50 are mixed and the mixture flow is distributed to the fire hole units 21 and 31 of each burner.

As shown in FIG. 4, when the plate-shaped burner 30 is mounted in the tube-shaped burner 20, a water tube 70 through which water circulates to cool the burner is provided, so  
25 that deformation such as buckling is prevented from occurring.

That is, the plate-shaped burner 30 is simply fitted into the loader 22 of the tube-shaped burner 20. In this case, the water tube 70 penetrates the insertion hole 12

formed in the lateral surface of the main casing 10 and fitted into a fitting hole 23 formed in the lateral surface of the tube-shaped burner 20 and a fitting hole 33 formed in the pin structure 32 formed on the bottom surface of the plate-shaped burner 30 in correspondence to the fitting hole 23 formed in the tube-shaped burner 20, to thereby firmly fix the tube-shaped burner 20 and the plate-shaped burner 30. As a result, water circulating along the water tube 70 can cool the overheated burner simultaneously.

In other words, since the cooling water tube 70 penetrates the pin structure 32 formed in the lower end of the plate-shaped burner 30, heat generated in the upper fire hole unit 31 is discharged through the pin structure 32 although the burner is overheated. In this case, water is supplied through the cooling water tube 70 to cool the burner. As a result, the premixed combustion gas burner according to the present invention has a merit that deformation such as buckling due to thermal tension caused by overrunning the burner.

Also, if the temperature of flames is lowered through a cooling function of the cooling water circulating through the water tube 70, a more amount of nitrogen oxide generated can be reduced and damage by a fire due to heat cumulated on the burner surface can be prevented.

In particular, the cooling water tube 70 plays a role of fixing the tube-shaped burner 20 and the plate-shaped burner 30 when the plate-shaped burner 30 is mounted in the loaders 22 of the tube-shaped burner 20, as well.

Here, a reference numeral 80 shown in FIG. 5 denotes a tension bolt 80. The tension bolt 80 penetrates the front faces of the mixture supply tubes 40 from the rear surface of the main casing 10, to thereby firmly fix the main casing 10 and the mixture supply tubes 40. A reference numeral 41 denotes an inhaled air outlet 41 which is provided in the lower end of the front surface of the mixture supply tubes 40, for discharging air inhaled through the air blower 50.

As described above, the premixed combustion gas burner according to the present invention having a structure that the tube-shaped burner 20 and the plate-shaped burner 30 can be separated from each other has a structure of a typical premixed combustion gas burner

and thus has a merit of the typical premixed combustion gas burner.

That is, the length of the flames in whole is reduced and the temperature of flames is lowered as well. Thus, a load for an identical area is reduced to thereby reduce generation of polluted materials such as mono-oxide and nitrogen oxide.

5 Also, the premixed combustion gas burner according to the present invention having a structure that the tube-shaped burner 20 and the plate-shaped burner 30 can be separated from each other has structural characteristics that the present invention can be easily fabricated into a burner assembly having a relatively smaller size and higher load in comparison with the conventional Bunsen burner and premixed combustion gas burner, and  
10 that the present invention can easily change a design of the premixed combustion gas burner by varying the number of burners according to a target heat capacity of a full load in the burner.

That is, referring to FIG. 5, three premixed combustion gas burners are disposed in parallel with one another as an embodiment of the present invention. However, the present  
15 invention is not limited in the above-described embodiment. Although a number of premixed combustion gas burners are disposed in parallel with one another, the number of operating burners can be varied according to a desired calory.

In particular, the output of the burner in the present invention is influenced by the number of the plates where the fire hole units are disposed. Thus, a burner capacity is  
20 easily changed according to the number of plates and the size of the fire holes.

Also, since the fire hole units are separated into several pieces in the present invention, a twisted degree due to thermal expansion is minimized although the burner surface is cumulatively heated, and maintenance of the running performance of the burner is more excellent in comparison with the conventional premixed combustion gas burners.

25 As described above, according to the present invention, even in the case that a total number of fire hole units formed on the surface of the burner are separated into several pieces, a twisted degree due to thermal expansion is minimized although the burner surface is cumulatively heated, to thereby prevent deformation due to thermal expansion, and easily

change the size and number of the fire hole units to easily change a total capacity of the burner. Therefore, the present invention provides a very useful and efficient invention having a merit of maintenance of the running performance of the burner which is more excellent in comparison with the conventional premixed combustion gas burners.

5           Also, in a premixed combustion gas burner having a tube-shaped burner and a plate-shaped burner which are separated from each other, according to the present invention, a cooling water tube penetrates a pin structure formed on the lower end of the plate-shaped burner, in order to cool an overheated burner through water circulating through the cooling water tube, to thereby prevent deformation of the burner such as buckling due to thermal  
10       tension existing in the burner which may be caused by an excessive running of the burner.

          Also, the temperature of flames is lowered through the cooling function as described above, to reduce an amount of nitrogen oxide to be produced, and to prevent damage by a fire due to cumulative heat on the burner surface.

          Also, the present invention is a very useful and efficient invention playing a role of  
15       making the water tube fixing the tube-shaped burner and the plate-shaped burner.

          It is apparent to one who is skilled in the art that there are many variations and modifications without departing off the spirit of the present invention and the scope of the appended claims.